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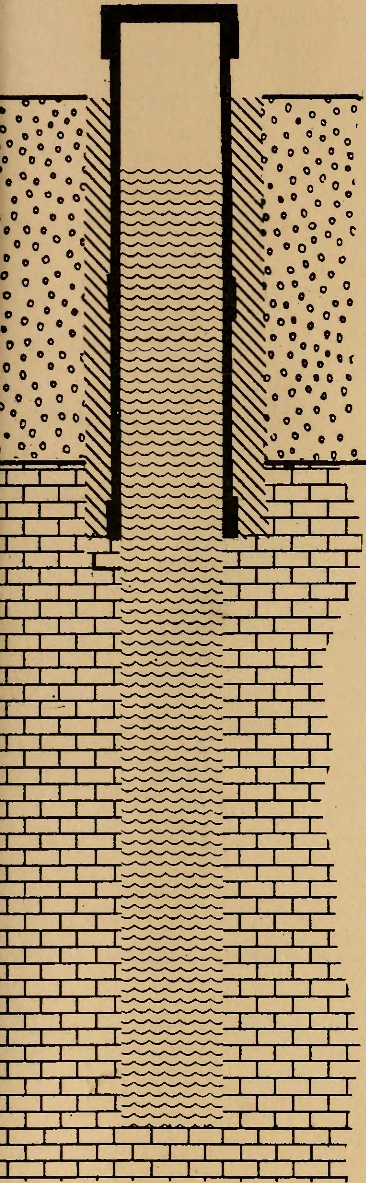
WELL - CONSTRUCTION REGULATIONS AND STANDARDS



North Carolina
Board of Water and Air Resources

MAY 20, 1775

Department of Water and Air Resources

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NORTH CAROLINA
BOARD OF WATER AND AIR RESOURCES

Department of Water and Air Resources

Raleigh
September
1971

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In accordance with Chapter 87, Article 7, Section 87-87 of the North Carolina General Statutes and pursuant to a public hearing held at Raleigh, North Carolina on April 15, 1971, North Carolina Well Construction Regulations and Standards governing the location, construction, repair and abandonment of wells, and the installation and repair of pumps and pumping equipment were adopted by the Board of Water and Air Resources the 26th day of August 1971, to be effective January 1, 1972.

George E. Pickett, Director
DEPARTMENT OF WATER AND AIR RESOURCES

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STATE OF NORTH CAROLINA

Well-Construction Regulations and Standards

I. GENERAL PROVISIONS

A. Authorization

The North Carolina Board of Water and Air Resources is required, under the provisions of Chapter 87, Article 7, Section 87, General Statutes of North Carolina (Short Title: North Carolina Well Construction Act) to adopt appropriate rules and regulations governing the location, construction, repair, and abandonment of wells, and the installation and repair of pumps and pumping equipment.

B. Purpose

The ground-water reservoirs are the only source of fresh water that has not been polluted to some degree, and more than half the population obtains its water supply from these reservoirs. It is estimated that approximately one million wells have been drilled in North Carolina and that many thousands are constructed each year for domestic, agricultural, municipal, industrial and commercial water supplies. Improper location, construction, use and abandonment of wells is contributing to impairment of the ground-water resources throughout the State and to individual water supplies. Consistent with the duty to safeguard the public welfare, safety, health, and to protect and beneficially develop the ground-water resources of the State, it is declared to be the policy of this State to require that the location, construction, repair, and abandonment of wells, and the installation of pumps and pumping equipment conform to such reasonable standards and requirements as may be necessary to protect the public welfare, safety, health, and ground-water resources.

C. Scope

No person shall construct, repair, or abandon, or cause to be constructed, repaired or abandoned any well; nor shall any person install, repair, or cause to be repaired any pump or pumping equipment contrary to the provisions of the Well Construction Act and these regulations and standards. Previously adopted Procedures and Requirements of the North Carolina Well Construction Act and Driller Registration Act are superseded by these regulations and standards. Other Department regulations relating to well construction are incorporated in these regulations and standards.

D. Conflict with Other Laws and Regulations

The provisions of any Federal, State, County, or Municipal law or regulation establishing standards affording greater protection to the public welfare, safety, health, and the ground-water resources shall prevail within the jurisdiction of such agency or municipality over standards established by these regulations.

E. Penalities

Any person violating any provision of Article 7, Chapter 87, General Statutes of North Carolina or regulations issued thereunder, or order pursuant thereto, shall be subject to a penalty of one hundred (100) dollars. In addition, if any person is adjudged to have committed such violation willfully, the court may determine that each day during which such violation continued constitutes a separate violation.

II. DEFINITIONS

A. As used herein, unless the context otherwise requires:

1. "Abandoned well" means a well whose use has been discontinued, or which is in such a state of disrepair that continued use for obtaining ground water or other useful purpose is impracticable.
   a. "Temporary abandonment" means any usable well which has been temporarily removed from service because of well or pump maintenance, newly constructed wells not yet put into service, etc.
   b. "Permanent abandonment" means any well removed from or not yet put into service, whose use is impracticable because of faulty construction, location, water quality, insufficient yield, unserviceable casing and screens, completion of testing or intended use.
2. "Access port" means an opening in the well casing or well head installed for the primary purpose of determining the position of the water level in the well.

3. "Agent" means any person who by mutual and legal agreement with a well owner has authority to act in his behalf in executing applications for permits. The agent may be either general agent or a limited agent authorized to do one particular act.

4. "Aquifer" means a geologic formation, group of such formations, or a part of such a formation that will yield usable quantities of water to wells.

5. "Artesian well" means a well tapping a confined or artesian aquifer.

6. "Board" means the North Carolina Board of Water and Air Resources or its successor, unless otherwise indicated.

7. "Consolidated rock" means rock that is firm and coherent, solidified or cemented, such as granite, gneiss, limestone, slate or sandstone, that has not been decomposed by weathering.

8. "Construction of wells" means all acts necessary to construct wells for any intended purpose or use, including the location and excavation of the well, placement of casings, screens, and fittings, development and testing.

9. "Contamination" means the act of introducing into water foreign materials of such nature, quality, and quantity as to cause degradation of the quality of the water.

10. "Domestic use" means water used for drinking, bathing, or culinary purposes.

11. Grout mixtures:

    a. "Neat cement grout" means a mixture of not more than 6 gallons of clear water to one 94 pound bag of portland cement.

    b. "Sand cement grout" means a mixture of not more than 2 parts sand and 1 part cement and not more than 6 gallons of clear water per 94 pound bag of portland cement.

12. "Installation of pumps and pumping equipment" means the procedure employed in the placement and preparation for operation of pumps and pumping equipment, including all construction involved in making entrances to the well and establishing seals.

13. "Liner pipe" means pipe that is installed inside a completed and cased well for the purpose of sealing off undesirable water or for repairing ruptured or punctured casing or screens.

14. "Municipality" means a city, town, county, district, or other public body created by or pursuant to State law or any combination thereof acting cooperatively or jointly.

15. "Nonpotable mineralized water" means brackish, saline, or other water containing minerals of such quantity or type as to render the water unsafe, harmful, or generally unsuitable for human consumption and general use.

16. "Owner" means any person who holds the fee or other property rights in the well being constructed. A well is real property and its construction on land rests ownership in the land owner in the absence of contrary agreement in writing.

17. "Person" shall mean any and all persons, including individuals, firms, partnerships, associations, public or private institutions, municipalities or political subdivision, governmental agencies, or private or public corporations organized or existing under the laws of this State or any other state or country.

18. "Polluted water" means water containing organic or other contaminants of such type and quantity as to render it unsafe, harmful or unsuitable for human consumption.

19. "Public water supply" means any water supply furnishing potable water to ten (10) or more residences or businesses, or combination of residences or businesses.

20. "Pumps" and "pumping equipment" means any equipment or materials utilized or intended for use in withdrawing or obtaining groundwater including well seals.

21. "Repair" means work involved in deepening, reaming, sealing, installing, or changing casing depths, perforating, screening, or cleaning, acidizing, or redevelopment of a well excavation, or any other work which results in breaking or opening the well seal.

22. "Specific capacity" means the yield of the well expressed in gallons per minute per foot of draw-down of the water level (gpm/ft-dd).

23. "Static level" means the level at which the water stands in the well when the well is not being pumped and is expressed as the distance from a fixed reference point to the water level in the well.

24. "Water supply well" means any well intended or usable as source of water supply, but not to include a well constructed by an individual on land which is owned or leased by him, appurtenant to a single family dwelling, and intended for domestic use (including household purposes, farm livestock, or gardens).

25. "Well" means any excavation that is cored, bored, drilled, jetted, dug or otherwise constructed for the purpose of locating, testing, or withdrawing ground-water, or for evaluating, testing, developing, draining or recharging any ground-water reservoirs or aquifer, or that may control, divert, or otherwise cause the movement of water from or into any aquifer. Provided, however, this shall not include a well constructed by an individual on land which is owned or leased by him, appurtenant to a single family dwelling, and intended for domestic use (including household purposes, farm livestock, or gardens).

26. "Well driller", "driller", or "water-well contractor" means any person, firm or corporation engaged in the business of constructing wells.

27. "Well head" means the upper terminal of the well including adapters, ports, valves, seals, and other attachments.

28. "Well seal" means an approved arrangement or device used to cap a well or to establish and maintain a junction between the casing or curbing of a well and the piping or equipment installed therein, the purpose or function of which is to prevent pollutants from entering the well at the upper terminal.
(1967, c. 1157, s. 3.)

III. REGISTRATIONS AND PERMITS

A. Driller Registration

1. Every person, firm or corporation engaged in the business of drilling, boring, coring or constructing wells in any manner with the use of power machinery in the State shall register annually with the Department of Water and Air Resources.
2. Registration shall be accomplished during the period from January 1 to January 31 of each year.
3. Registration shall be accomplished by completing and submitting to the Department a registration application form provided by the Department for this purpose.
4. Upon receipt of a properly completed application form, the applicant will be issued a Certificate of Registration.

B. Pump Installation Registration

1. All persons engaged in the business of installing and repairing pumps and other equipment in wells shall be registered with the Department.

C. Well Construction Permit

1. A Well Construction Permit shall be obtained from the Board prior to the construction of:
   a. Any water-well or well system with a designed capacity of one-hundred thousand (100,000) gallons per day (gpd) or greater.

   b. Any well added to an existing system of one-hundred thousand (100,000) gpd.

   c. Any public water supply, industrial, or irrigation well or well system.

   d. Any well in a geographical area where the Board finds, after public hearings, such permission to be reasonably necessary to protect the ground-water resources and the public welfare, safety, and health.

2. An application for a Permit to Construct a well shall be submitted by the owner or his agent in duplicate to the Department on forms furnished by the Department to include the following:
    a. The number of existing wells and their respective yields in the system.
    b. A diagram showing the location of each existing well in the system.
    c. The estimated withdrawal rate of each proposed well.
    d. A diagram of construction for each proposed well.
    e. A location diagram of each proposed well showing direction and distance to other wells in the system and two nearby map reference points (such as roads, intersections, or streams).
    f. All existing water-supply wells within a radius of 1,000 feet of each proposed well.
    g. The owner's name and mailing address.
    h. Such other information as the Board may reasonably deem necessary.
3. The location, design and operation of the well must be approved by the Department prior to construction.
4. It shall be the responsibility of the well contractor to see that a Permit has been issued prior to well construction.

D. Water Use Permit

1. A Water-Use Permit shall be obtained from the Board for the withdrawal of water in Capacity Use Areas in accordance with regulations established under the provisions of part 2, Article 21, Chapter 143, General Statutes of North Carolina.

IV. STANDARDS OF CONSTRUCTION FOR WATER-SUPPLY WELLS

A. Location

1. Except when prior written permission is granted by the Department, or an agency designated by the Department, the well shall be located:
    a. At a site not generally subject to flooding.
    b. At a minimum horizontal distance of fifty (50) feet from any water-tight sewage and liquid-waste collection facility (such as cast iron pipe).
    c. At a minimum horizontal distance of one hundred (100) feet from any other sewage or liquid-waste collection and disposal facility and any other source of potential pollution or contamination.
    d. At a minimum horizontal distance of ten (10) feet from any property boundary.
    e. At a site that permits access for maintenance, repair, treatment, testing, and such other attention as may be necessary.
2. Public water-supply wells shall be located:
    a. At a site approved by a delegated representative of the North Carolina State Board of Health.
    b. Insofar as possible, on a lot having minimum dimensions of 200 feet by 200 feet and that is owned or controlled by the person supplying the water.
    c. At a minimum horizontal distance of fifty (50) feet from any water-tight sewer constructed of cast-iron pipe with caulked or leaded joints.
    d. At a minimum horizontal distance of one-hundred (100) feet from any other sewer and any other source of potential pollution or contamination.
    e. At a site that is well drained.

3. No source of potential pollution or contamination such as septic tanks and drain fields shall be located within one-hundred (100) feet of a well without prior permission from the Department or agency designated by the Department.

B. Source of Water

1. Except when otherwise approved by the Department, or in areas as may be designated by the Department, the source of water for any well intended for domestic use shall be:

   a. At least twenty (20) feet below the surface of the ground, and

   b. From a water-bearing zone or aquifer that is not polluted.

C. Drilling and Casing

1. The well shall be constructed so that a pump with a capacity equal to the yield of the well (within the practical limits of pumps for a given diameter well) can be installed and operated without binding or without interference by contact with any part of the well.

2. All water-bearing zones that are known to contain polluted water shall be adequately cased and cemented off so that pollution of underlying or overlying water-bearing zones will not occur.

3. All water-bearing zones containing nonpotable mineralized water that are encountered or penetrated in well construction shall be adequately cased or cemented off, as conditions may require, so that contamination of overlying or underlying water bearing zones will not occur.

4. Drilling fluids shall be obtained from an uncontaminated source, or shall be disinfected.

5. Except when otherwise approved by the Department, the well shall be cased with the bottom of the casing extending at least twenty (20) feet below the land surface.

6. The top of the casing shall be terminated, by the drilling contractor at least twelve (12) inches above land surface.

7. The well shall be adequately cased to prevent formation material from entering the well after the well has been developed and completed by the drilling contractor.

8. The casing in wells constructed to obtain water from a consolidated rock formation shall be firmly seated and sealed to a depth of at least one (1) foot below the top of the consolidated rock (see fig. 1).

9. The casing in wells constructed to obtain water from an unconsolidated rock formation (such as gravel, sand or shells), shall extend at least to the top of the water-bearing formation.

10. Except when prior approval in writing has been obtained from the Department or as otherwise specified in these regulations, the permanent well casing shall:

    a. Be new, seamless or electric-resistance welded steel pipe, equivalent in weight to "standard weight" steel pipe as classified by the American Society for Testing and Materials (ASTM).

    b. Have water-tight joints that may be electrically welded, or threaded and coupled with heavy recessed-type couplings. The coupling should completely cover the threads when made power tight.

    c. Be equipped with a drive shoe when the casing is seated in a consolidated rock formation and any other wells if the casing is driven.

    d. If galvanized, galvanizing shall comply with the requirements of the latest revision of ASTM Specification A120.

11. Casing weighing less than "standard weight" steel pipe is not recommended by the Department for water-supply wells. However, casing of six and five-eighths (6-5/8) inches outside diameter weighing less than "standard weight" steel pipe will be permitted if the following requirements are met:

    a. The owner prefers casing weighing less than "standard weight" steel pipe.

b. The casing shall have a minimum weight of 13 pounds per foot when threaded and coupled.

c. The casing shall have a minimum nominal wall thickness of 0.185 inches.

d. The casing shall meet the requirements for Water Well Casing Pipe of ASTM-A589-70 specifications.

12. The Department recommends a minimum casing inside diameter of at least three (3)" inches. However, wells of smaller diameter may be constructed when the well owner prefers a well less than three (3) inches in diameter. The well owner should be made aware by the drilling contractor of the disadvantages of a small diameter well (see Appendix, Section A-1).

D. Grouting

1. The Department recommends that the annular space between the casing and formation be completely filled with cement grout. However, below a depth of twenty (20) feet below land surface cement grout, clay, or cuttings may be used to fill the annular space.

2. Unless otherwise approved by the Department, neat-cement or sand-cement grout shall be placed around the casing to a depth of at least twenty (20) feet below land surface by one of the following methods.

   a. The annular space between the casing and the formation shall be a minimum of one and five-tenths (1.5) inches. Neat-cement or sand-cement grout shall be pumped into place through a pipe extended to the bottom of the annular space which can be raised as the grout is applied. The grout pipe should remain submerged in grout during the entire application, or

   b. The annular space between the casing and formation shall be a minimum of three (3) inches and completely filled with neat-cement or sand-cement grout by a method that will insure complete filling of the space, or

c. An outer casing shall be installed to a minimum depth of twenty (20) feet. Neat-cement grout shall be pumped under pressure through the bottom of this casing until it fills the annular space around the casing and overflows at the surface. The grout shall have a minimum thickness of one and five-tenths (1.5) inches.

E. Well Screens

1. The well, if constructed to obtain water from an unconsolidated rock formation, shall be equipped with a screen that will adequately prevent the entrance of formation material into the well after the well has been developed and completed by the well contractor (see fig. 2).

2. The well screen shall:

   a. Be of a standard design and manufactured specifically for the purpose of well construction.

   b. Be of steel, brass, bronze or other Department approved material and shall be of a strength to satisfactorily withstand chemical and physical forces applied to it during and after installation.

   c. Be of a design to permit the optimum development of the aquifer with minimum head loss consistent with the intended use of the well. The openings shall be designed to prevent clogging and shall be free of rough edges, irregularities or other defects that may accelerate or contribute to corrosion or clogging.

   d. Be provided with such fittings as are necessary to seal the top of the screen to the casing and to close the bottom. If the screen is installed inside the casing, a lead-packer seal or other approved device shall be used to seal the screen, or screen extension to the casing.

3. Multi-screened wells shall not connect aquifers or zones which have differences:

   a. In water quality that would result in deterioration of the water quality in any aquifer or zone.

b. In static water levels that would result in depletion of water from any aquifer or zone, or significant loss of head in any aquifer or zone.

F. Gravel-Packed Wells

1. In constructing a gravel-packed well: (see fig. 3)

   a. The gravel shall be composed of quartz, granite, or similar rock material and shall be clean, rounded, uniform, water-washed and free from clay, silt, or other deleterious material.

   b. The size of the gravel shall be determined from a grain size analysis of the formation material.

   c. The gravel shall be placed in the annular space around the screens and casing by a fluid circulation method, preferably through a conductor pipe to insure accurate placement and avoid bridging.

   d. The gravel pack shall have a minimum thickness of at least three (3) inches.

   e. The gravel shall be disinfected by adding sufficient chlorine to the placement fluid to produce a chlorine residual of at least 100 parts per million (ppm).

   f. For gravel-packed wells in which the top of the gravel does not extend inside an outer casing, a cement grout plug of at least five (5) feet in thickness shall be placed in the annular space directly on top of the gravel. The remaining space shall be filled with cement grout or clay, except the upper twenty (20) feet which shall be filled with cement grout unless otherwise approved by the Department.

   g. The gravel pack shall not connect aquifers or zones which have differences:

      (1) In water quality that would result in deterioration of the water quality in any aquifer or zone.
      (2) In static water levels that would result in depletion of

water from any aquifer or zone, or significant loss of head in any aquifer or zone.

G. Large Diameter Wells Cased with Concrete Pipe (See fig. 4)

1. A standard type water-supply well, cased with "standard-weight" steel pipe, is recommended by the Department for domestic use. However, a large-diameter well, cased with concrete pipe and commonly referred to as a "bored" well, may be constructed when it is not practical or possible to construct a standard-type well, or when the owner prefers a "bored" well. The well owner should be made aware by the drilling contractor that this type well is not recommended by the Department where a standard well is possible (see Appendix, Section A-2).

2. If the casing joints are not sealed, the construction shall be as follows:

   a. The bore hole shall have a minimum diameter of six (6) inches larger than the outside diameter of the casing.

   b. The annular space around the casing shall be filled with neat or sand-cement grout to a depth of at least twenty (20) feet below land surface unless otherwise approved by the Department.

   c. The annular space around the casing below the grout shall be filled with sand or gravel.

   d. The gravel-pack shall have a minimum thickness of at least three (3) inches.

   e. The gravel-pack material shall be composed of quartz, granite, or similar rock material and shall be clean, rounded, uniform, water-washed and free from clay, silt, or other deleterious material.

   f. The gravel shall be sterilized prior to or during the installation with a solution containing at least one-hundred (100) parts per million residual chlorine.

3. If the casing joints are sealed, the bore hole shall have a minimum diameter of six (6) inches larger than the outside diameter

of the casing to a depth of at least twenty (20) feet below land surface. The annular space around the casing shall be filled with neat or sand-cement grout to a depth of at least twenty (20) feet below land surface unless otherwise approved by the Department.

4. The well head shall be completed in the same manner as required for other water-supply wells.

H. Well Development

1. Every well shall be properly developed by the drilling contractor.
2. Development shall include removal of:
    a. Formation cuttings and mud from the entire depth of the well.
    b. Drilling fluids and additives.
    c. Any formation material from the water bearing zones or other source that may enter the well as a result of pumping at a rate within the limits of the reported yield.

I. Well Identification Plate

1. Every well shall be equipped by the drilling contractor immediately after completion of the drilling with an identification plate.
    a. The identification plate shall be constructed of a durable, weatherproof, rustproof metal or equivalent material approved by the Department.
    b. The identification plate shall be securely attached to the well casing or enclosure floor around the casing where it is readily visible (see fig. 5).
    c. The identification plate shall not be removed from the well unless otherwise approved by the Department.
    d. The identification tag shall be stamped with a permanent marking to show the following information:
        (1) Drilling contractor and registration number.
        (2) Date well completed.
        (3) Total depth of well.

(4) Casing: Depth (ft.) Inside Diameter (in.)

(5) Screened intervals (of screened wells).

(6) Gravel interval (of gravel-packed wells).

(7) Yield or specific capacity expressed in gallons per minute (gpm), or gallons per minute per foot of drawdown (gpm/ft.-dd). For "bored" wells, may be stamped on identification plate within thirty (30) days after completion.

(8) Static water level and date measured.

Well Identification Plate

Water-Well and Pump Company
Registration Number 000
Raleigh, N. C.

Date Completed ______________________ 19__________

Depth: ______________ ft.

Casing: Depth __________ ft. Diameter __________ In.

Screen Interval: ______________ to ______________

______________ to ______________

Gravel Interval: ______________ to ______________

Static Water Level: ______________ Date ______________

Yield ______________________ gpm, or

Specific Capacity ______________ gpm/ft.dd

J. Well-Head Completion and Equipment

1. The top of the casing shall be cut off smooth and level, be free from dents and cracks, and shall terminate at least six (6) inches above the concrete slab around the casing.

2. The identification plate, if removed or obscured, shall be relocated and securely attached to the well casing or enclosure floor around the casing by the person completing the well head.

3. All piping, wiring, and vents shall enter the well above land surface.

4. The well-head shall be completely enclosed except on wells with

turbine or other type pumps designed for outdoor installation.

a. The enclosure shall be well drained and constructed to prevent the entrance of surface and rain water, insects and rodents, and to protect the well-head equipment against freezing.

b. The enclosure shall have a concrete floor with a thickness of at least four (4) inches and extend at least two (2) inches above land surface. The enclosure floor shall slope away from the well casing in all directions.

c. The surface of the ground shall be graded to slope away from the well-head enclosure in all directions.

5. Every well shall be equipped by the person completing the well-head with a usable access port.

a. The access port shall be located directly on top of the well if the pump is offset from the well (see fig. 5).

b. For wells on which the pump is installed directly over the well, an access port pipe shall be installed through the pump base or outside of the well casing, and terminate inside the well casing at some point below the base of the pump (see fig.6).

c. The access port shall have a minimum inside diameter of five-tenths (0.5) inches, so that the position of the water level may be determined by measurement with a steel or electric tape through the access port.

d. The access port shall be installed and maintained in such a manner as to prevent the entrance of water, dust, insects, or other foreign material, and to permit ready access for water-level measurements.

e. Although the Department does not recommend using the well casing as part of the pump intake pipe, when pumping equipment of this type is installed in wells having an inside diameter of more than two (2) inches, the access port shall be constructed as follows: (see fig. 7)

(1) A pipe having a minimum inside diameter of five-tenths

(0.5) inches shall be installed outside of and attached to the casing at intervals of ten (10) feet or less. The pipe shall extend from the well head to a depth below the pumping water level and lift capacity of the pump, and terminate inside the casing; or

(2) A pipe having a minimum inside diameter of five-tenths (0.5) inches shall be installed inside the casing, extending through the well head and to a depth below the pumping water-level and lift capacity of the pump.

6. Every artesian well that flows under natural artesian pressure shall be equipped with a valve so that the flow can be completely stopped.

   a. The person completing the well head shall be responsible for installation of valves on wells constructed on or after the effective date of these regulations.

   b. The well owner shall be responsible for maintenance of valves and installation of valves on wells constructed previous to the effective date of these regulations.

K. Departure from Construction Standards Without Prior Approval

If the driller shall fail to secure any prior permission of the Department required by this section IV and the Department shall thereafter refuse to approve the well, such well shall be the sole responsibility of the driller and the owner shall not be liable to the driller for any costs or expenses for the drilling and installation of the well.

V. STANDARDS OF CONSTRUCTION FOR WELLS OTHER THAN WATER SUPPLY

A. Recharge and Disposal Wells

1. No well shall be constructed or used for recharge, injection or disposal purposes without prior permission from the Board of Water and Air Resources.

2. Permits may be issued by the Board of Water and Air Resources only

after consultation with and recommendation by the State Board of Health.

B. Observation Wells

1. Observation wells installed for a temporary (not to exceed a period of six (6) months) purpose of obtaining hydrologic or other data shall be constructed by such methods and of such materials that they are not a source or channel of pollution or contamination to any ground-water supply or aquifer.

2. Permanent observation wells constructed for the purpose of obtaining hydrologic or other data shall meet the standards of construction for water supply wells, except when prior permission has been obtained in writing from the Department.

C. Test Holes and Borings

1. Test holes shall be permanently abandoned by the drilling contractor within fifteen (15) days after the drilling, logging, and testing have been completed, unless:

   a. The owner or his agent has submitted a request in writing for authorization to extend the time limit, or

   b. The well is being completed as a water-supply or other type well.

D. Dewatering and Depressurizing Wells

1. The design and construction specifications for any dewatering and depressurizing well or well system shall be approved in writing by the Department.

E. Mining Wells

1. The design and construction specifications for all wells intended for the purpose of recovering minerals and ores shall be approved in writing by the Department.

F. Elevator Shafts

1. Wells constructed or holes drilled for the installation of elevator

shafts or hydraulic cylinders shall be cased, sealed, and maintained in such a manner as to prevent them from being a channel allowing the vertical movement of water and a source of contamination to the ground-water supply, or any aquifer, and as approved by the Department.

G. Oil and Gas Wells

1. Wells constructed for exploration or production of oil and gas shall be cased from the surface to at least the first significant clay layer (thickness of ten (10) feet or greater) below fresh water (containing less than 1,000 ppm of dissolved solids) with new, seamless or electric-resistance welded steel pipe equivalent in weight to "standard weight" steel pipe as classified by the American Society for Testing and Materials (ASTM).

2. Neat cement grout shall be pumped under pressure through the bottom of the casing in a continuous operation until it fills the annular space around the casing and overflows at the surface.

H. All Other Wells

1. All other wells shall be constructed in accordance with standards for water-supply wells except when prior approval has been obtained from the Department.

VI. PUMPS AND PUMPING EQUIPMENT

A. The pumping capacity of the pump shall be consistent with the intended use and yield characteristics of the well.

B. The pump and related equipment for the well shall be conveniently located to permit easy access and removal for repair and maintenance.

C. The base plate of a pump placed directly over the well shall be designed to form a watertight seal with the well casing or pump foundation.

D. In installations where the pump is not located directly over the well, the annular space between the casing and pump intake or discharge piping shall be closed with a watertight seal preferably designed specifically for this purpose.

E. The well shall be properly vented at the well head to allow for pressure changes within the well.

F. A hose bib shall be installed at the well head for obtaining water samples.

G. A priming tee shall be installed at the well head in conjunction with jet pump installations.

H. Any suction line installed underground between the well and pump shall be surrounded by six (6) inches of cement, or encased in a larger pipe that is sealed at each end.

I. The drop piping and electrical wiring used in connection with the pump shall meet underwriters specifications acceptable to the Department.

J. Contaminated water shall not be used for priming the pump.

VII. WELL TESTS FOR YIELD

A. Domestic Wells

The drilling contractor shall test the well for capacity by one of the following or other methods that may be approved by the Department:

1. Pump method
   - a. Select a permanent measuring point, such as the top of the casing.
   - b. Measure and record the static water level below or above the measuring point prior to starting the pump.
   - c. Measure and record the discharge rate at intervals of ten (10) minutes or less.
   - d. Measure and record water levels using a steel or electric tape at intervals of ten (10) minutes or less.
   - e. Continue the test for a period of at least one (1) hour.
   - f. Make measurements within an accuracy of plus or minus twenty-five-hundredths (.25) of a foot.

2. Bailer method
   a. Select a permanent measuring point, such as the top of the casing.
   b. Measure and record the static water-level below or above the measuring point prior to starting the bailing procedure.
   c. Bail the water out of the well as rapidly as possible for a period of at least one (1) hour. Determine and record the bailing rate in gallons per minute at the end of the bailing period.
   d. Measure and record the water-level immediately after stopping bailing process.
3. Air Rotary Drill Method
   a. Measure and record the amount of water being injected into the well during drilling operations.
   b. Measure and record the discharge rate in gallons per minute at intervals of one (1) hour or less during drilling operations.
   c. After completion of the drilling, continue to blow the water out of the well for at least thirty (30) minutes and measure and record the discharge rate in gallons per minute at intervals of ten (10) minutes or less during the period.
   d. Measure and record the water level immediately after discharge ceases.
4. Air Lift Method
   a. Measurements shall be made through a pipe placed in the well.
   b. The pipe shall have a minimum inside diameter of at least five-tenths (0.5) inches and shall extend from the top of the well head to a point inside the well that is below the bottom of the air line.
   c. Measure and record the static water level prior to starting the air compressor.

d. Measure and record the discharge rate at intervals of ten (10) minutes or less.

e. Measure and record the pumping level using a steel or electric tape at intervals of ten (10) minutes or less.

f. Continue the test for a period of at least one (1) hour.

B. Public, Industrial and Irrigation Wells

Every public, industrial and irrigation well upon completion, shall be tested for capacity by the drilling contractor (except when the owner specifies another agent) by the following or equivalent method unless otherwise approved by the Department:

1. The water level in the well to be pumped and any observation wells shall be measured and recorded prior to starting the test.
2. The well shall be tested by a pump of sufficient size and lift capacity to satisfactorily test the yield of the well, consistent with the well diameter and purpose.
3. The pump shall be equipped with sufficient throttling devices to reduce the discharge rate to approximately twenty-five (25) percent of the maximum capacity of the pump.
4. The test shall be conducted for a period of at least twenty-four (24) hours without interruption and shall be continued for a period of at least four (4) hours after the pumping water level stabilizes (ceases to decline).
5. The pump discharge shall be set at a constant rate or rates that can be maintained throughout the testing period. If the well is tested at two (2) or more pumping rates (a step-drawdown test), the pumping water level shall be stabilized for a period of at least four (4) hours for each pumping rate.
6. The pump discharge rate shall be measured by an orifice meter, flowmeter, weir, or equivalent metering device. The metering device shall have an accuracy within plus or minus five (5) percent.

7. The discharge rate of the pump and time shall be measured and recorded at intervals of ten (10) minutes or less during the first two (2) hours of the pumping period for each pumping rate. If the pumping rate is relatively constant after the first two (2) hours of pumping, discharge measurements and recordings may be made at longer time intervals but not to exceed one (1) hour.

8. The water level in each well and time shall be measured and recorded at intervals of five (5) minutes or less during the first hour of pumping and at intervals of ten (10) minutes or less during the second hour of pumping. After the second hour of pumping, the water level in each well shall be measured at such intervals that the lowering of the pumping water level does not exceed twenty-five-hundredths (.25) of a foot or three (3) inches between measurements.

9. A reference point for water-level measurements (preferably the top of the casing) shall be selected and recorded for the pumping well and each observation well to be measured during the test. All water level measurements shall be made from the selected reference points.

10. All water-level measurements shall be made with a steel or electric tape or equivalent measuring device.

11. All water-level measurements shall be made within an accuracy of plus or minus twenty-five-hundredths (.25) of a foot or three (3) inches.

12. After the completion of the pumping period, measurements of the water-level recovery rate, in the pumped well, shall be made for a period of at least two (2) hours in the same manner as the drawdown.

VIII. CHLORINATION OF WELLS

A. All wells shall be disinfected upon completion of construction, maintenance, repairs, pump installation and testing as follows:

1. Chlorine shall be placed in the well in sufficient quantities to

produce a chlorine residual of at least one-hundred (100) parts per million (ppm) in the well (see table 1). A chlorine solution may be prepared by dissolving high test calcium hypochlorite (trade names include HTH, Chlor-Tabs, etc.) in water. About 0.12 lbs. or 2 ounces of hypochlorite containing 70 percent available chlorine is needed per 100 gallons of water for a 100 ppm chlorine residual. As an example, a well having a diameter of six inches, has a volume of about 1.5 gallons per foot. If the well has 200 feet of water, the minimum amount of hypochlorite required would be 0.36 lbs. (1.5 x 200 feet = 300 gallons, 0.12 lbs. per 100 gallons, 0.12 x 3 = 0.36 lbs.)

2. The chlorine shall be placed in the well by one of the following or equivalent methods:
    a. Chlorine tablets may be dropped in the top of the well and allowed to settle to the bottom.
    b. Chlorine solutions shall be placed in the bottom of the well by using a bailer or by pouring the solution through the drill rod, hose, or pipe placed in the bottom of the well. The solution shall be flushed out of the drill rod, hose, or pipe by using water or air.
3. Agitate the water in the well to insure thorough dispersion of the chlorine.
4. The well casing, pump column and any other equipment above the water level in the well shall be thoroughly rinsed with the chlorine as a part of the disinfecting process.
5. The chlorine shall stand in the well for a period of at least twenty-four (24) hours.
6. The well shall be pumped until the system is clear of the chlorine before the system is placed in use.
7. A sample of the water should be analyzed and found safe for human consumption.

IX. MAINTENANCE AND REPAIR OF WELLS AND PROTECTION OF THE GROUND WATER RESOURCES

A. Every well shall be maintained in a condition whereby it will conserve and protect the ground-water resources, and whereby it will not be a source or channel of contamination or pollution to the water supply or any aquifer.

1. All materials used in the maintenance, replacement, or repair of any well shall meet the requirements for new installation.

2. Broken, punctured or otherwise defective or unserviceable casing, screens, fixtures, seals, or any part of the well head shall be repaired or replaced, or the well shall be properly abandoned.

3. National Science Foundation (NSF) approved PVC pipe rated at 160 PSI may be used for liner casing. The liner casing shall be installed with centering guides to insure proper centering in the well. The annular space around the liner casing shall be at least five-eighths (5/8) inches and shall be completely filled with neat-cement grout.

4. Valves on all flowing wells shall be closed except when a beneficial use of the water is being made.

5. Repairs to wells completed with the well head terminating below ground (buried seal) should include extending the well casing above land surface as follows:

   a. A tapered sleeve should be inserted inside of and should extend at least six (6) inches down into the existing casing. The extension casing should be welded or bonded to the existing casing around the outside of the joint, or

   b. A sleeve should be heated and swedged over the existing casing with at least six (6) inches of overlap.

   c. Cement grout should be placed around the casing, extending from land surface to a depth of at least one (1) foot below the joint formed by the casings. The grout should have a minimum thickness of one and five-tenths (1.5) inches.

X. ABANDONMENT OF WELLS

A. Temporary

1. When any well is temporarily removed from service or prior to putting into service, the well shall be sealed with a water-tight cap or seal.

2. The well shall be maintained whereby it is not a source or channel of contamination during temporary abandonment.

B. Permanent

1. All casing and screen materials may be salvaged except casing that has been cemented in place.

2. In the case of gravel-packed wells in which the casing and screens have not been removed, the casing shall be perforated opposite the gravel pack at intervals not exceeding ten (10) feet.

3. The well shall be checked from land surface to the entire depth of the well before it is sealed to insure freedom from obstructions that may interfere with sealing operations.

4. The well shall be thoroughly chlorinated prior to sealing.

5. "Bored" wells shall be completely filled with cement grout or dry clay compacted in place.

6. Wells constructed in unconsolidated formations shall be completely filled with cement grout by introducing it through a pipe extending to the bottom of the well which can be raised as the well is filled.

7. Wells constructed in consolidated rock formations or that penetrate zones of consolidated rock may be filled with sand or gravel opposite the zones of consolidated rock. The top of the sand or gravel fill shall be at least five (5) feet below the top of the consolidated rock. The remainder of the well shall be filled with cement grout only.

8. Test wells less than fifty (50) feet in depth shall be abandoned

in such a manner as to prevent the well from being a channel allowing the vertical movement of water and source of contamination to the ground-water supply, and as approved by the Department.

9. The owner shall be responsible for permanent abandonment of a well except:

   a. As otherwise specified in these regulations.

   b. As mutually agreed upon in a written contract with the driller.

   c. Abandonment is a result of improper location, construction, or completion by the driller, or the driller fails to meet the conditions of his contract; in which case the driller is responsible for abandonment of the well.

XI. DATA AND RECORDS REQUIRED

A. Well Cuttings

1. Samples of formation cuttings shall be collected and furnished to the Department of Water and Air Resources, except as otherwise approved by the Department:

   a. From all wells requiring a permit.

   b. From all exploratory, test, or water supply wells drilled for public, industrial, or irrigation supplies.

   c. From all exploratory, test, or water-supply wells drilled for State or County agencies, and institutions, or on State or County property.

   d. From all exploratory, test, or injection wells drilled for disposal or recharge purposes.

   e. From all exploratory, test, water supply, or other wells drilled to a depth of 250 feet or more in and east of Richmond, Moore, Harnett, Johnston, Wilson, Edgecombe, Halifax, and Northampton Counties, except oil test wells for which samples are required by laws administered by the

North Carolina Department of Conservation and Development.

f. From all wells drilled within a Capacity Use Area except when the Board specifies that such samples are not required.

g. From all other wells when such samples are requested by the Department.

2. Samples or representative cuttings shall be obtained for depth intervals of ten feet or less beginning at the land surface. Representative cuttings shall also be collected at depths of each significant change in formation.

3. Samples of cuttings shall be placed in containers furnished by the Department and such containers shall be filled, sealed and properly labeled with indelible-type markers, showing the well owner, well number if applicable, and depth interval the sample represents.

4. Each set of samples shall be placed in a suitable container(s) showing the location, owner, well number if applicable, driller, depth interval, and date.

5. Samples shall be retained by the driller until delivery instructions are received from the Department or for a period of at least 60 days after the well record form (GW-1), indicating said samples are available, has been received by the Department.

6. The furnishing of samples to any person or agency other than the Department of Water and Air Resources shall not constitute compliance with the Department's request and shall not relieve the driller of his obligation to the Department.

B. Reports

1. Any person completing or abandoning any well shall submit a record of the construction or abandonment to include the location, size, depth, casing record, method of finishing or abandoning, formation log, static water level, pumping water level, yield, pump type, capacity and setting, and records of any surveys, geophysical logs,

tests, or water analyses made.

2. The report shall be submitted as follows:
    a. To the Department of Water and Air Resources.
    b. To the well owner.
    c. On forms furnished by the Department.
    d. Within thrity (30) days after completion of construction or abandonment.
    e. Certified by the contractor or person completing the construction of abandonment.

XII. APPENDICES

A. Disadvantages of Certain Types of Wells

1. Small Diameter Wells

The Department recommends that casing less than three (3) inches inside diameter not be used for water-supply wells because of the disadvantages which include:

a. Maintenance is difficult or impossible, and often when a problem occurs, the small diameter well has to be abandoned and replaced with a new well.

b. A usable access port is difficult to install.

c. Proper installation of a screen is generally difficult.

d. The casing wall is thinner, reducing the potential well life in corrosive water.

e. The yield of the well may be restricted because of small intake area and friction loss in the pipe.

f. It may be necessary to use the casing as part of the pump intake pipe.

g. The type and lift capacity of the pump is restricted, so that lowering of the water level in the vicinity of the well by drought or increased pumping may require replacement of the well to accommodate a suitable pump.

2. Large Diameter Wells Cased with Concrete Pipe

The Department recommends that a standard-type well be constructed when it is practical or possible because of the disadvantages of the "bored" well which include:

a. Water may seep through concrete pipe, especially at unsealed joints, which makes the well difficult to protect from contamination.

b. "Bored" wells are vulnerable to pollution from nearby septic tanks and drain fields.

c. Many "bored" wells are completed only a few feet below the water table and the supply is generally inadequate for typical domestic requirements.

d. Many "bored" wells go dry during significant periods of drought.

e. "Bored" wells are difficult and expensive to properly abandon because of the large volume and type of material required to fill the well.

NORTH CAROLINA
DEPARTMENT OF WATER AND AIR RESOURCES
DIVISION OF GROUND WATER
P. O. Box 27048 - Raleigh, North Carolina 27611
Phone - (Area Code 919) 829-3003

APPLICATION
REGISTRATION OF WELL DRILLING CONTRACTOR

1. Name of Applicant (person, firm, etc.)__________

2. Address__________

3. County__________ Telephone__________

4. Check one of the following:

☐ New ☐ Renewal ☐ No longer in the drilling business

5. Number and type of drill rigs to be operated under this registration:

Number	Type	Number	Type
____	__________	____	__________
____	__________	____	__________

6. Counties in which you expect to drill under this registration:

________	________	________	________
________	________	________	________
________	________	________	________
________	________	________	________

7. Approximate number of wells drilled per year:

Domestic______ Industrial______ Public Supply ______ Other ______

8. Average depth of wells drilled: ________. Average depth cased: ______
Diameter(s): ________.

9. Remarks (forms needed, sample bags, etc.)__________

____

Date __________ ____________________
(Signature of Contractor or Representative)

For Department use only:

Registration No. __________ Date __________

NORTH CAROLINA
BOARD OF WATER AND AIR RESOURCES

APPLICATION FOR PERMIT TO CONSTRUCT A WELL

_______________ 19_____

TO: North Carolina Board of Water and Air Resources

Gentlemen:

In accordance with the provisions of Article 7, Chapter 87, General Statutes of North Carolina, and regulations pursuant thereto, application is hereby made by _______________ for a permit to construct a well
(name of well owner)
as described below and in the accompanying data submitted as a part of this application.

(a) Name of property owner_______________

(b) Location of property_______________
(Road, Community, Subdivision, Lot No.) Town County

(c) Purpose of well_______________

(d) Will proposed well replace an existing well_______________

(e) Total capacity of existing system:_______________ gallons per day

Well No.	Yield	Well No.	Yield

(f) Proposed well:

Construction type_______________(open-end, screened, gravel-packed, etc.)

Estimated depth _______________Estimated yield_______________

Estimated date of construction: Begin _______________ Complete _______________

(g) Drilling contractor: _______________

(h) Location of Well: Provide a detailed map showing the location of the proposed well and any wells in the existing system to at least two (2) nearby reference points such as roads, intersections, and streams. Identify roads with State Highway road identification numbers. Show all existing water supply wells within a radius of 1,000 feet of the proposed well.

(i) Well Construction Diagram: Provide a diagram showing proposed construction specifications. (See Form GW-22A)

The Applicant hereby agrees the proposed well will be constructed in accordance with approved specifications and conditions of the Well Construction Permit.

____
Mailing Address of Well Owner (Required)

____
Mailing Address of Agent

____
Signature of Well Owner or Agent

____
Title

PERMIT NO._______ issued _______19_____.

FORM GW-22

WELL RECORD

NORTH CAROLINA DEPARTMENT OF WATER AND AIR RESOURCES
DIVISION OF GROUND WATER
P. O. BOX 27048-RALEIGH, N. C. 27611

DRILLING CONTRACTOR ____ REG. NO. ____ WELL CONSTRUCTION PERMIT NO. ____

1. WELL LOCATION: (Show a sketch of the location on back of form)
Nearest Town: ____ County: ____
____ Quadrangle No. ____
(Road, Community or Subdivision and Lot No.)

2. OWNER: ____

3. ADDRESS: ____

4. TOPOGRAPHY: draw, valley, slope, hilltop, flat

5. USE OF WELL: ____ DATE: ____

6. DOES THIS WELL REPLACE AN EXISTING WELL? ____

7. TOTAL DEPTH: ____ RIG TYPE OR METHOD: ____

8. FORMATION SAMPLES COLLECTED: ☐ YES No. of Bags ____

9. CASING:

Depth			Inside Diam.	Wall thick. or weight/ft.	Type
From ____	to ____	ft.	____	____	____
____	____		____	____	____
____	____		____	____	____

10. GROUT:

Depth			Material	Method
From ____	to ____	ft	____	____
____	____		____	____

11. SCREEN:

Depth			Diam.	Type and Opening
From ____	to ____	ft.	____	____
____	____		____	____
____	____		____	____

12. GRAVEL:

Depth			Size	Material
From ____	to ____	ft.	____	____
____	____		____	____

13. WATER ZONES (depth): ____
____

14. STATIC WATER LEVEL: ____ ft. above / below top of casing.
Casing is ____ ft. above land surface. ELEV. ____
DATE MEASURED: ____

15. YIELD (gpm): ____ METHOD OF TESTING: ____

16. PUMPING WATER LEVEL: ____ ft. after ____ hours
at ____ gpm.

17. CHLORINATION: Type ____ Amount ____

18. WATER QUALITY: ____ TEMPERATURE (°F) ____

19. PERMANENT PUMP: (Show a sketch of well head on back of form)
Date Installed ____ Type ____ Make ____
Capacity ____ (gpm) HP ____
Intake Depth ____ Airline Depth ____

20. HAVE YOU INFORMED THE WELL OWNER OF THE DEPARTMENTS REQUIREMENTS AND RECOMMENDATIONS? ____

21. REMARKS: ____
____

DRILLING LOG

DEPTH		
FROM	TO	FORMATION DESCRIPTION

I do hereby certify that this well record is true and exact.

____
SIGNATURE OF CONTRACTOR OR AGENT DATE

White copy - Department of Water and Air Resources; Blue - Driller's copy; Green - Owner's copy.

Form GW-1

WELL HEAD COMPLETION: Draw a sketch of the well head showing casing, pump piping, seals, vents, access port, grout, and enclosure.

WELL LOCATION: Draw a location sketch showing the direction and distance of the well to at least two (2) nearby reference points such as roads, intersections and streams. Identify roads with State Highway road identification numbers.

NORTH CAROLINA DEPARTMENT OF WATER AND AIR RESOURCES
DIVISION OF GROUND WATER
P. O. Box 27048 - Raleigh, N. C. 27611

WELL ABANDONMENT RECORD

CONTRACTOR______________________________ REG. NO.__________

1. WELL LOCATION: (Show a sketch of the location on back of form.)

Nearest Town:______________________________ County______________________

______________________________ Quadrangle No.______________
(Road, Community, Subdivision, Lot No.)

2. OWNER:______________________________

3. ADDRESS:______________________________

4. TOPOGRAPHY: draw, slope, hilltop, valley, flat

5. USE OF WELL:______________ DATE:__________

6. TOTAL DEPTH:______________ DIAMETER:__________

7. CASING REMOVED:

feet	diameter
______	______
______	______

8. SEALING MATERIAL:

Neat cement		Sand cement	
bags of cement	____	bags of cement	____
gals. of water	____	yds. of sand	____
		gals. of water	____

Other
Type material______________________________
Amount______________________________

9. EXPLAIN METHOD OF EMPLACEMENT OF MATERIAL

____
____
____
____

I do hereby certify that this well abandonment record is true and exact.

____
Signature of Contractor or Agent   Date

WELL DIAGRAM: Draw a detailed sketch of the well showing total depth, depth and diameter of screens remaining in the well, gravel interval, intervals of casing perforations, and depths and types of fill materials used.

WELL LOCATION: Draw a location sketch showing the direction and distance of the well to at least two (2) nearby reference points such as roads, intersections and streams. Identify roads with State Highway road identification numbers.

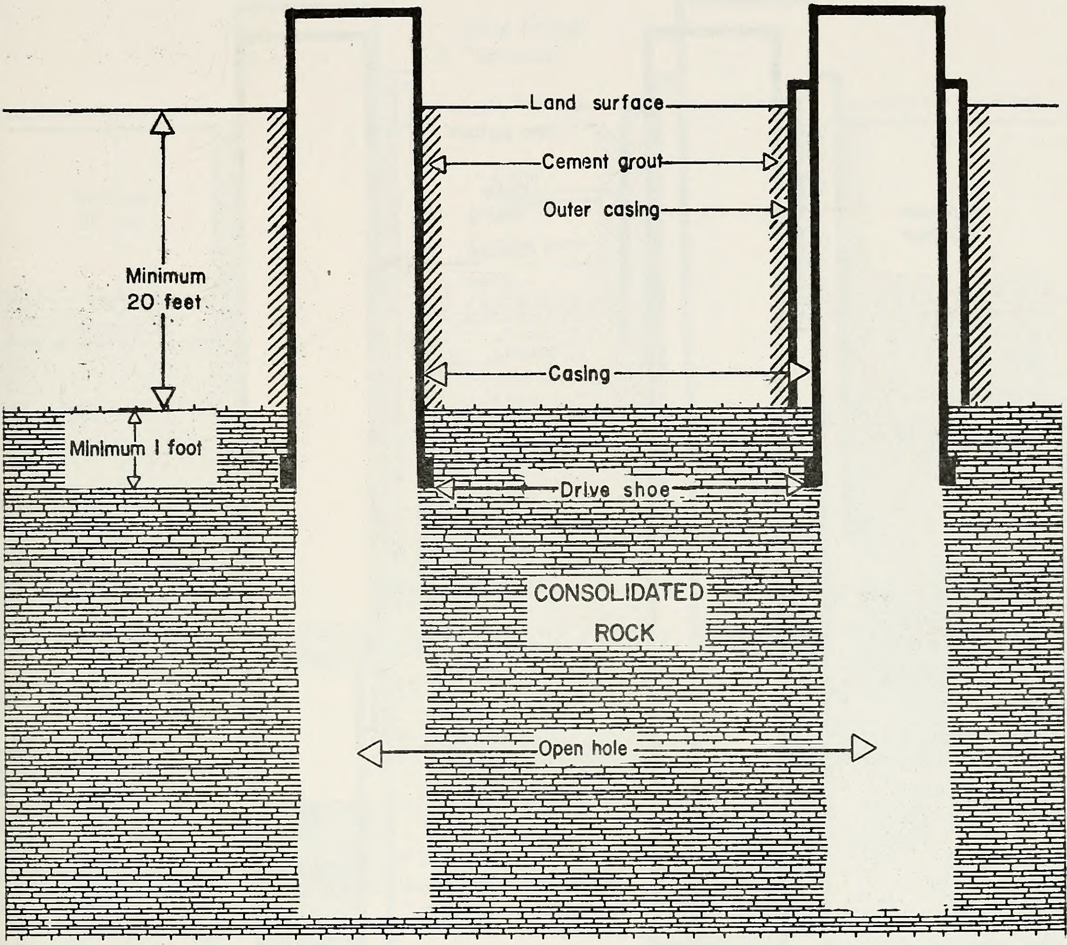

FIGURE 1.- DIAGRAMS SHOWING CONSTRUCTION OF OPEN-END WELLS

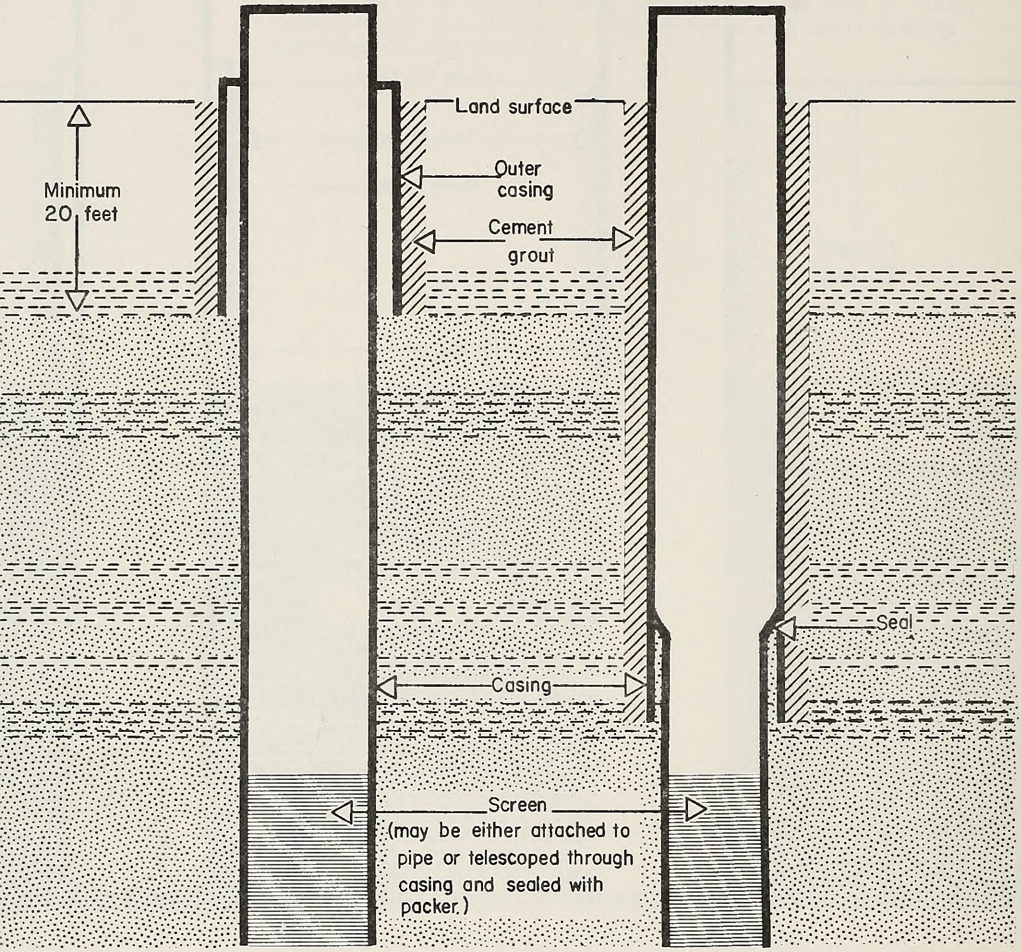
Land surface
Outer casing
Cement grout
Minimum 20 feet
Seal
Casing
Screen
(may be either attached to pipe or telescoped through casing and sealed with packer.)

FIGURE 2.- DIAGRAMS SHOWING CONSTRUCTION OF SCREENED WELLS.

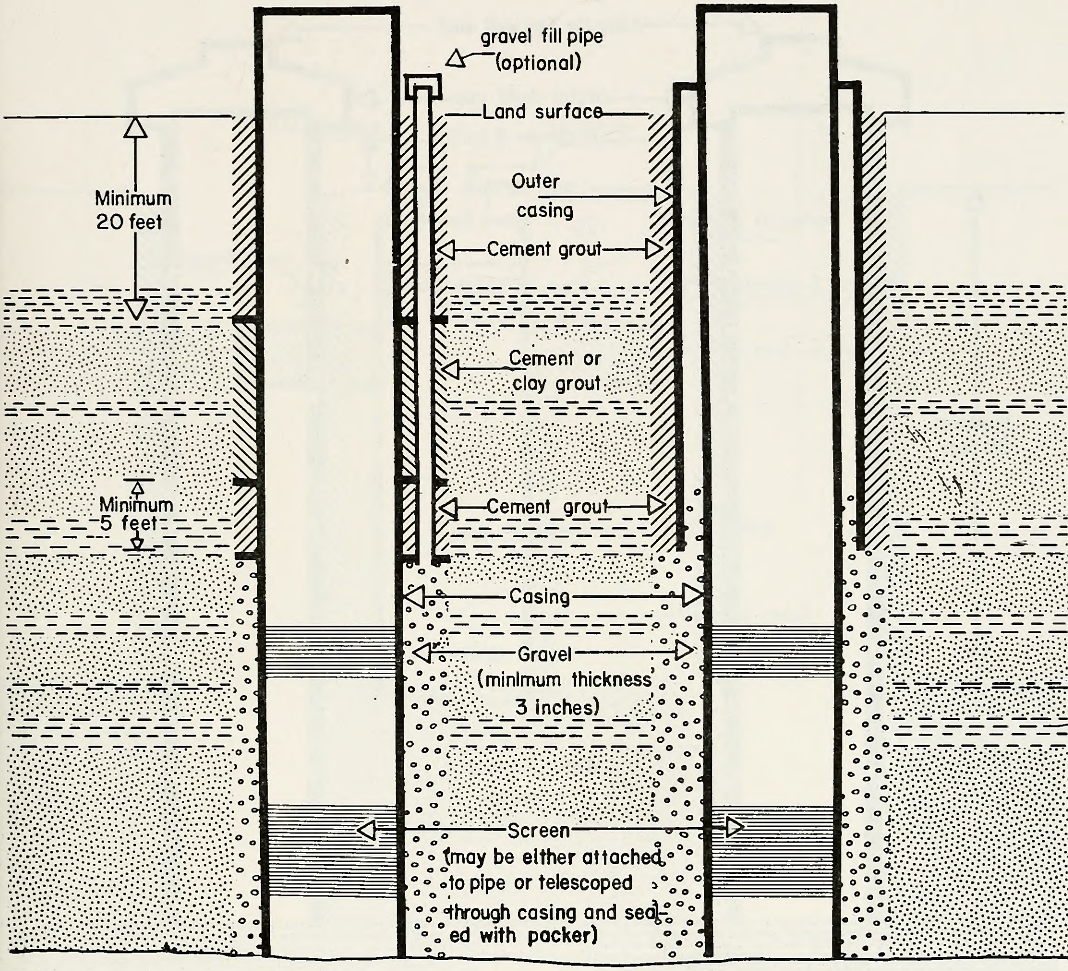
gravel fill pipe (optional)
Land surface
Minimum 20 feet
Outer casing
Cement grout
Cement or clay grout
Minimum 5 feet
Cement grout
Casing
Gravel (minimum thickness 3 inches)
Screen (may be either attached to pipe or telescoped through casing and sealed with packer)

FIGURE 3.- DIAGRAMS SHOWING CONSTRUCTION OF GRAVEL-PACKED WELLS.

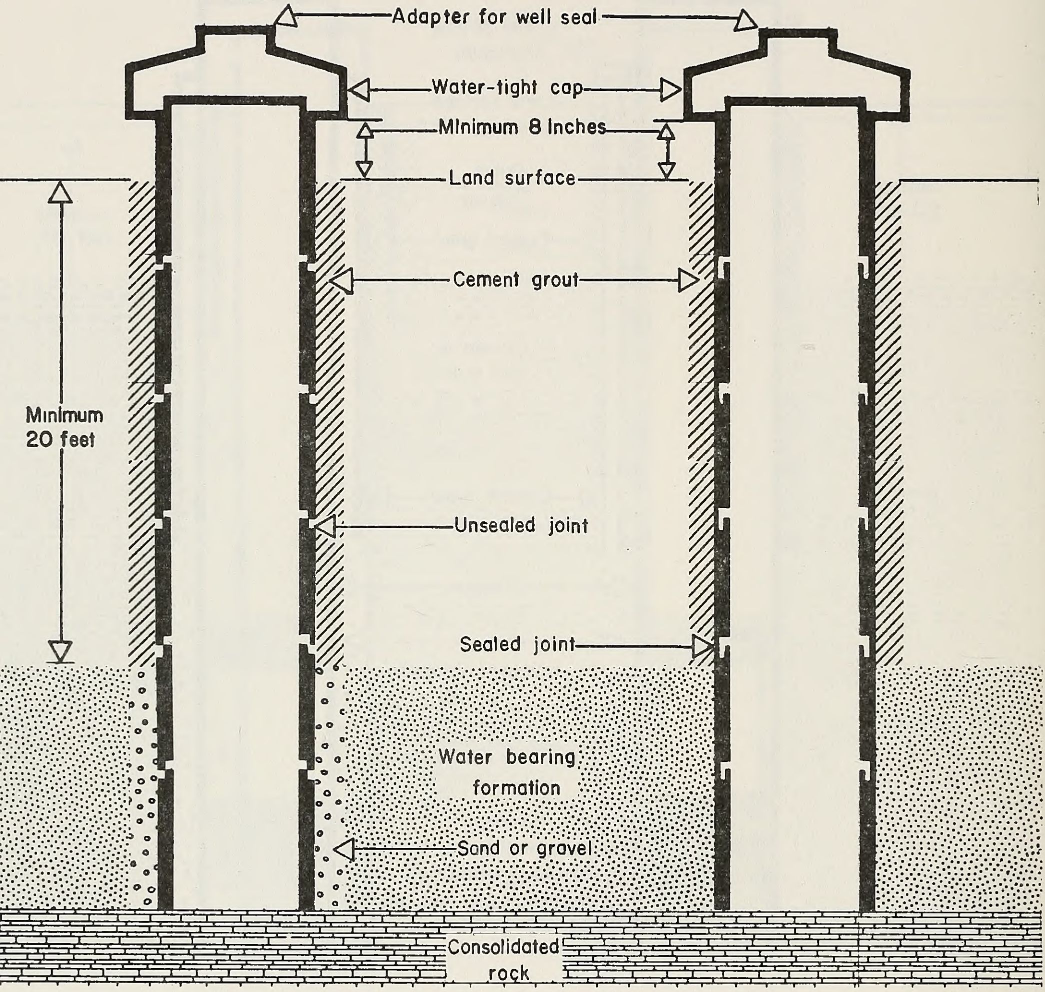

FIGURE 4.- DIAGRAM SHOWING CONSTRUCTION OF LARGE DIAMETER WELLS CASED WITH CONCRETE PIPE.

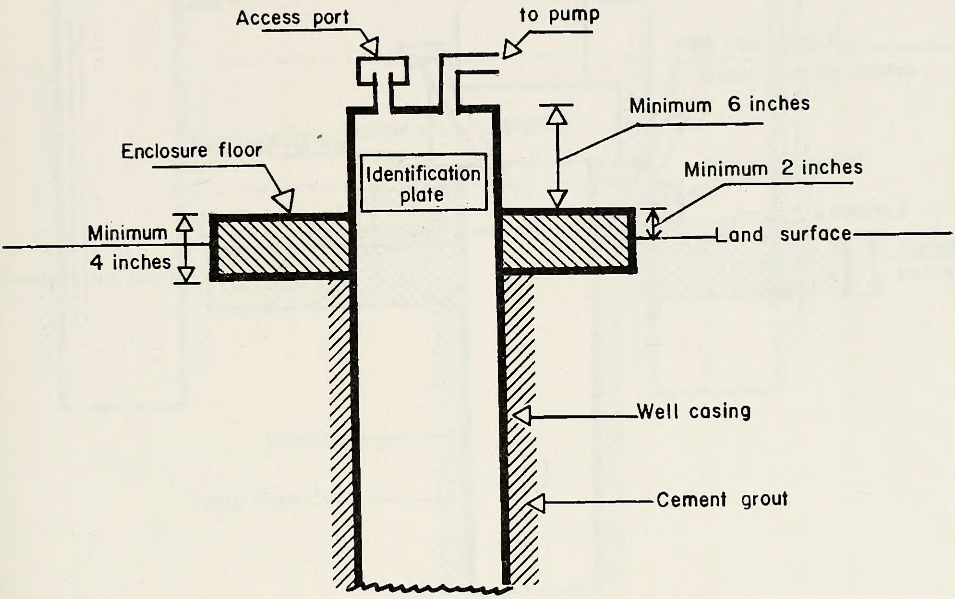

FIGURE 5.- DIAGRAM SHOWING COMPLETION OF WELL HEAD WITH PUMP OFFSET FROM THE WELL.

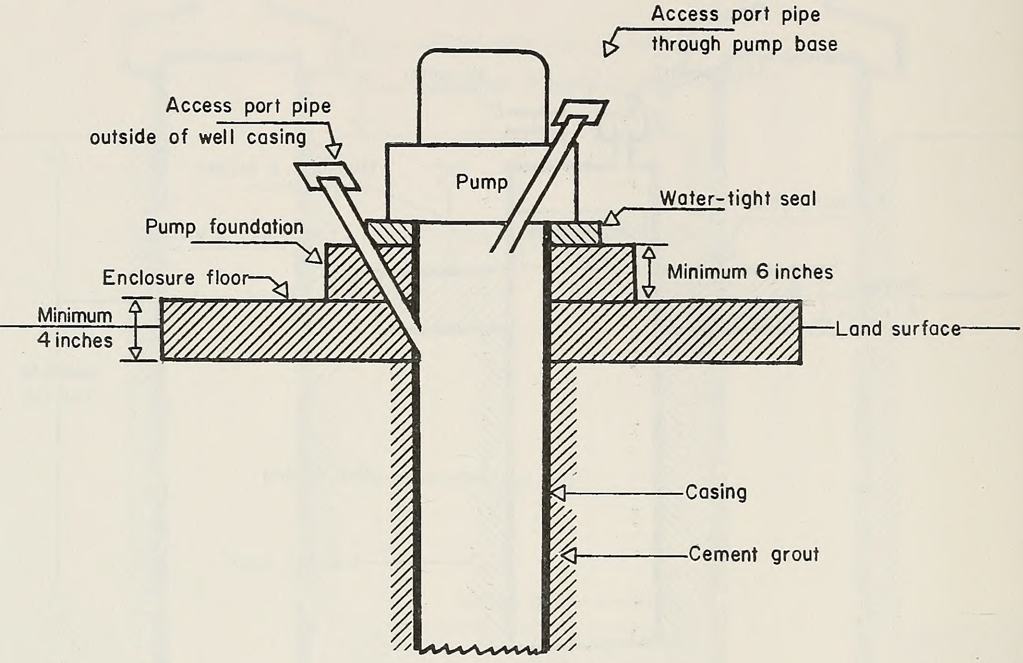

FIGURE 6.- DIAGRAM SHOWING COMPLETION OF WELL HEAD AND INSTALLATION OF ACCESS PORT WITH PUMP LOCATED DIRECTLY OVER THE WELL.

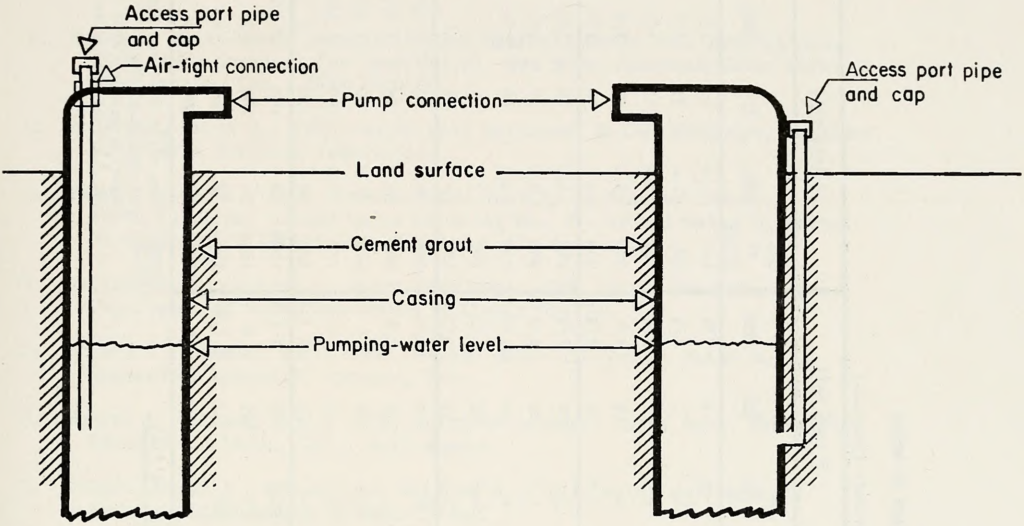

FIGURE 7. - DIAGRAM SHOWING ACCESS PORT ON WELLS IN WHICH THE CASING IS USED AS PART OF THE PUMP-INTAKE PIPE.

CHLORINE TABLE FOR STERILIZATION OF WELLS

(Based on Seventy percent (70%) Available Chlorine)

	4 inch Well				6 inch Well				8 inch Well				10 inch Well			
Feet of Water	Gal of Water	Oz	Tab	Cups	Gal of Water	Oz	Tab	Cups	Gal of Water	Oz	Tab	Cups	Gal of Water	Oz	Tab	Cups
10	7	.14	1	1/4	15	.3	2	1/4	25	.5	4	1/4	40	.8	6	1/4
20	14	.28	2	1/4	30	.6	4	1/4	50	1	7	1/4	80	1.6	11	1/4
30	21	.42	3	1/4	45	.9	6	1/4	75	1.5	11	1/4	120	2.4	17	1/3
40	28	.56	4	1/4	60	1.2	8	1/4	100	2	14	1/4	160	3.2	22	1/3
50	35	.70	5	1/4	75	1.5	10	1/4	125	2.5	16	1/3	200	4	28	1/2
60	40	.84	6	1/4	90	1.8	12	1/4	150	3	21	1/3	240	4.8	34	1/2
70	49	.96	7	1/4	105	2.1	14	1/4	175	3.5	24	1/2	280	5.6	39	2/3
80	56	1.1	8	1/4	120	2.4	17	1/3	200	4	28	1/2	320	6.4	45	3/4
90	63	1.3	9	1/4	135	2.7	19	1/3	225	4.5	32	1/2	360	7.2	50	1
100	70	1.4	10	1/4	150	3.0	21	1/3	250	5	35	2/3	400	8	56	1
120	84	1.7	12	1/4	180	3.6	25	1/2	300	6	42	3/4	480	9.6	67	1 1/4
140	98	2	14	1/4	210	4.2	29	1/2	350	7	49	3/4	560	11.2	78	1 1/2
160	112	2.2	15	1/4	240	4.8	34	1/2	400	8	56	1	640	12.8	90	1 1/2
180	126	2.5	17	1/3	270	3.4	38	2/3	450	9	63	1	720	14.4	100	1 3/4
200	140	2.8	20	1/3	300	6	42	3/4	500	10	70	1 1/4	800	16	112	2
250	175	3.5	24	1/2	375	7.5	52	1	625	12.5	88	1 1/2	1000	20	140	2 1/2
300	210	4.2	29	1/2	450	9 9	63	1	750	15	105	2	1200	24	168	3
400	280	5.6	39	3/4	600	12	84	1 1/2	1000	20	140	2 1/2	1600	32	224	4
500	350	7	49	1	750	15	105	2	1250	26	182	3	2000	40	280	5

WEIGHT FORMULA : Ounces = $\frac{\text{(ppm Chlorine residual)} \times (8.34) \times \text{(gallons of water)} \times (16)}{(1{,}000{,}000) \times \text{(percent chlorine)}}$

Measures: 7 Tablets = 1 ounce
8 ounces = 1 cup

NOTE: This table does not apply for chlorox, B.K. Powder or any other chlorine product with less than 70% available chlorine.

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